SCHEME OF VALUATION

(Scoring Indicators)

Revision:2015 Course Code:1004

Course Title: Engineering Chemistry-I

Q No	Scoring Indicator	Split up score	Sub Total	Total
I.	PART-A			
1.	Boiling and Clarke's process (Name only)	1+1		2
2.	According to Bronsted-Lowry concept an acid is a substance that can donate proton(H^+) and base is a substance that can accept a proton(H^+) acid definition - 1 mark base definition - 1 mark	1+1		2
3.	Nanochemistry is the study of materials of size 1 to 100nm range. $1nm = 10^{-9}m$ definition - 1 Any 2 example	1 ½+½	1+1	2
4.	Any two physical properties.	2		2
5.	Solder - Pb (50%) and Sn (50%)			2

II

PART-B

1(a) A substance that can enhance the activity of a catalyst is called promoter. definition - 1 mark — 1m

Any one example - ½ mark

A substance which can decrease the activity of a catalyst is called poison. definition - 1 mark — ½m+½m = 3

Any one example. ½ mark — 1m

b). Nanomaterials provide large surface area. Hence they act as better catalyst.

- Tumors can be ~~detet~~ detected and located with incredible accuracy
- Newborns will have their DNA mapped quickly

(Any 3 applications) — 3

---

2. (a) NaOH

Equivalent weight = $\frac{\text{molecular weight}}{\text{acidity / basicity}}$

NaOH =

M. W = 1 × 23 + 1 × 16 + 1 × 1

= 40 acidity - 1 — 1m

E. W = $\frac{40}{1}$ = 40

H_2SO_4 — 3

M. W = 2 × 1 + 1 × 32 + 4 × 16

= 98 basicity - 2 — 1m

E. W = 98/2 = 49

2 (b) $p^H = -\log [H^+]$ 1

$p^{OH} = -\log [OH^-]$ 1 3

$p^H + p^{OH} = p^{Kw} = 14$ 1

3 (a) Clarke's process - This is the method for removing temporary hardness. ½

Required quantity of slaked lime, $Ca(OH)_2$ is added to water, when calcium and magnesium ions are precipitated as insoluble carbonates. 1½ 3

$Ca(HCO_3)_2 + Ca(OH)_2 \longrightarrow 2CaCO_3\downarrow + 2H_2O$ 1

$Mg(HCO_3)_2 + Ca(OH)_2 \longrightarrow MgCO_3\downarrow + CaCO_3\downarrow + 2H_2O$

(b) The process of removing salts present in water is called desalination. 1

The principle of reverse osmosis is that when a hydrostatic pressure greater than osmotic pressure is applied on the concentrated solution solvent is forced to move from concentrated solution to dilute solution across the membrane 1½ 3

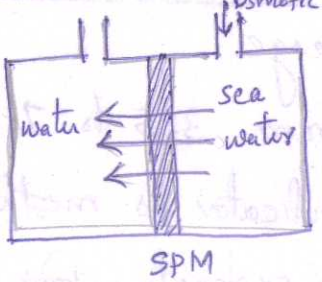

fig ½

SPM

4 (a) Any three impurities of steel — 1½
~~properties~~ their effect on its properties — 1½ — 3

(b) • It can remove ionic, non-ionic, colloidal and high molecular weight organic impurities
• Capital cost required is less
• Only maintenance cost is for the replacement of membranes.
(any three) — 1+1+1 — 3

5 (a) • Carbon nanotubes are very strong
• They have high thermal conductivity
• They conduct electricity
(any three) — 1+1+1 — 3

(b) Fundamental particles are; electron, proton, and neutron — 1½

Mass
Electron - 9.1×10^{-31} kg
Proton - 1.67×10^{-27} kg — 1½
Neutron - 1.67×10^{-27} kg — 3

6 (a) $HCl \times Na_2CO_3$ - Methyl orange — 1
In this titration pH changes from 3.5 to 7.5 at the end point. A suitable indicator is methyl orange of pH range 3.1 to 4.5 (explanation - 2mark) — 2 — E.2 — 3
~~$H_2SO_4 \times NaOH$ - methyl orange or phenolphthalein~~ — ½ — 3
~~In this type of titration, pH changes from 4 to 10 at the end point. Hence indicators which changes its colour between pH 4 and 10 can be used (explanation)~~

	(b) Normality - definition or equation Molarity - definition or equation For an acid, $N = M \times$ Basicity For a base, $N = M \times$ acidity	1 1 1		3
7	(a) Any three uses of powder metallurgy: Filaments of electric bulbs, Bearings for automobiles, electric clock etc (b) Bronze - Copper, and Tin Any two uses - used for making statues, coins etc.	1+1+1 1 2		3 3

PART - C

UNIT - I

III (a) When the catalyst and reactant are in the same phase, the process is known as homogeneous catalysis. 2

eg: $2SO_{2(g)} + O_{2(g)} \xrightarrow{NO(g)} 2SO_3$

$2CO_{(g)} + O_{2(g)} \xrightarrow{NO(g)} 2CO_2$ (any two examples) 1

(b) When the reactant and catalyst are in different phase, the process is known as heterogeneous catalysis. 2

eg: $2SO_{2(g)} + O_{2(g)} \xrightarrow{Pt(s)} 2SO_3$

$N_{2(g)} + 3H_{2(g)} \xrightarrow{Fe(s)} 2NH_3$ 1

(any two examples) 6

(b) They are strengtheners of composite materials, They act as heat conductors, They act as electrical conductors or semiconductors, They used in photovoltaic industry, They act as molecular size test tubes or capsules for drug delivery. (any five applications) 5

	(c) Atom • Atom is the smallest particle of an element • It may or may not exist in the free state • It is indivisible by chemical means. • It can directly take part in chemical reactions. (Any four points)	Molecule • Molecule is the smallest particle of an element or compound. • It can always exist in the free state • It can split by chemical means • Molecules split into atoms and take part in chemical reactions.	4
	OR		
IV	(a) Carbon nanotube is a structure which seems to be formed by rolling a sheet of graphite into the shape of a cylindrical shape.		2½
	There are two varieties of CNT SWCNT and MWCNT		½
	SWCNT is just a single cylinder whereas MWCNT consists of multiple concentric nanotube cylinders.		2
	Based on orientations of lattices, they are armchair, chiral and zigzag.		1
			6

(b) Any two methods; (name only) HiPCO, CVD etc ½+½

Explanation 2+2 5

(c) Atomic number - definition ~~or equate~~

Mass number - definition ½+½

$^{23}_{11}Na$	electrons - 11	$^{12}_{6}C$ electrons-6	$^{1}_{1}H$ electrons-1
	protons - 11	protons-6	protons-1 1+1+1
	neutrons - 12	neutrons-6	neutrons-0 4

V

UNIT-II

(a) An acidic buffer is obtained by mixing a weak acid & its salt with a strong base (definition) 2

Eg: Acetic acid and sodium acetate (any one example) 1

A basic buffer is prepared by mixing a weak base and its salt with a strong acid (definition) 2

Eg: NH_4OH and NH_4Cl (any one example) 1 6

(b) According to Arrhenius concept, all substances which contain hydrogen and give H^+ ions when dissolved in water are called acids while those which contains hydroxyl group and give OH^- ions when dissolved in water are called bases (definitions) 1½

Arrhenius acid - HCl, Arrhenius base - NaOH ½+½

According to Lewis concept, an acid is a substance which is capable of accepting an electron pair and base is a substance which is capable of donating an electron pair. 1½

Lewis acid - BF_3, Lewis base - NH_3 ½+½ 5

(c) Normality equation; $N_1V_1 = N_2V_2$ ——— 1

$N_1 = 0.11N$
$V_1 = 25ml$
$N_2 = ?$
$V_2 = 20ml$ } ——— ½

$\therefore N_2 = \frac{N_1V_1}{V_2}$ ——— ½ 4

$N_2 = \frac{0.11 \times 25}{20} = \frac{2.75}{20}$ } ——— 2

$= 0.1375N$

OR

VI (a) $W = 3.65g$
$V = 250ml$ } ½

$N = \frac{W \times 1000}{E \times V}$ } 1

$N = \frac{3.65 \times 1000}{36.5 \times 250} = 0.4N$ ——— 1½

Using Normality equation; $N_1V_1 = N_2V_2$ ——— ½

$N_1 = 0.4N$ $N_2 = 0.12N$
$V_1 = ?$ $V_2 = 25ml$ } ½ 6

$V_1 = \frac{N_2V_2}{N_1} = \frac{0.12 \times 25}{0.4}$

$= \frac{3}{0.4} = 7.5ml$ } 2

(b) • To find out acidic, basic, or neutral nature of a medium
• In the production of potable water
• Effluent treatment
• Digestive system
• Electroplating (any five) — 5

(c) ~~Water undergoes ionisation to a very small extent producing H^+ and OH^- ions.~~

$$H_2O \rightleftharpoons H^+ + OH^-$$

(c) The product of the concentration of the H^+ and OH^- ions in water is called ionic product of water Kw. — 2

$$Kw = [H^+][OH^-], \quad Kw = 10^{-14} \text{ moles}^2/\text{lit}^2$$ — 1+1 — 4

UNIT- III

VII (a) Permanent hardness is due to the presence of chlorides & sulphates of calcium and magnesium. — 2

Hard water is first passed through a tank with a bed of cation exchanger (E-H) capable of removing all positive ions by exchange with H^+ ions

$$2E\text{-}H + Ca^{+2} \longrightarrow E_2\text{-}Ca + 2H^+$$ — 1½ — 6

Then water is passed through a second tank containing an anion exchanger (E-OH) capable of removing all anions.

$$E\text{-}OH + Cl^- \longrightarrow E\text{-}Cl + OH^-$$ — 1½

H^+ and OH^- formed combine to give water

$$H^+ + OH^- \longrightarrow H_2O$$ — 1

(b) • It should be clear and odourless
• It should be pleasant to taste
• It should be reasonably soft
• Total dissolved solids should be less than 500ppm
• It should be free from dissolved gases like CO_2, H_2S, NH_3 etc
(any five points) 5

(c) Soft water

• Soft water gives lather readily with soap solution.
• It does not form insoluble scum with soap
• Does not contain dissolved impurities like Ca & Mg salts
• It dissolves lead of lead pipes, leading to lead poisoning. 2

Hard water

• Hard water does not gives lather readily with soap solution. 4
• Forms insoluble scum with soap.
• Contain dissolved impurities like Ca & Mg ions. 2
• It does not dissolve lead from lead pipes.

OR

VIII (a) Generally purification of water involves the following steps;
screening, sedimentation, coagulation, filtration and sterilization. ½
Block diagram ½
screening - explanation, using bar screens or mesh 1
sedimentation - explanation - undisturbed for 6-12 hours. 1
coagulation - explanation - Adding certain chemicals like alum 1 6
filtration - explanation - using gravity sand filter. 1
sterilization - explanation - using Cl_2 or bleaching powder. 1

(b) Water can be sterilized by mixing bleaching powder to water and allowed to remain undisturbed for several hours. The chemical changes occurring are;

$$CaOCl_2 + H_2O \longrightarrow Ca(OH)_2 + Cl_2$$

$$Cl_2 + H_2O \longrightarrow HOCl + HCl$$

hypochlorous acid

$$HOCl \longrightarrow [O] + HCl$$

nascent oxygen

HOCl and nascent oxygen produced are powerful germicides. 3

Disadvantages:

- Excess if added will give bad taste and odour
- Calcium ions get introduced in water which makes it hard. 2

5

(c) Any four disadvantages of hard water 4

UNIT- IV

IX (a) Powder metallurgy consists of the following steps. Atomization, reduction, Chemical mixing, compacting Presintering and sintering

Atomization - The cleaned material is first melted in a furnace. The molten metal flowing out through the nozzle is subjected to a stream of compressed inert gas, when melt disintegrates into droplets and then into fine powder.

Reduction - Metal oxides can be reduced by H_2, C or CO.

eg: $WO_2 + 2H_2 \longrightarrow W + 2H_2O$

Chemical mixing - Some additives are added for ~~lubrib~~ lubrication and binding of metal powder. It reduces the friction between inter particles and helps in smooth movement of metal powder.

Compacting - It is the process of converting loose metal powder into well defined mass of particular size and shape.

Presintering - Binder in the green compact has to be removed before sintering. Two techniques are available to remove binders :- thermal debinding and solvent debinding.

Sintering - During this process, metal particles sinters, they bind together into coherent bodies. For this, the compacted, presintered particles are heated in a furnace to a temperature below the melting point of the metal. 6

(b) An alloy is a homogeneous solid mixture of two or more elements, one should be a metal. 2

- To increase the resistance to corrosion
- To increase the hardness of metal
- To modify colour

(any three) 3

5

	(c) Malleability Ductility Thermal conductivity (any 4 four points with explanation) Weldability			4
X	(a) Quenching - This is the process of heating steel at high temperature and suddenly cooling it by plunging in water or oil.	2		
	Tempering - Quenched steel is heated to a temperature about 550K, and cooled slowly.	2		6
	Nitriding - Steel is heated at a high temperature in presence of ammonia and cooled slowly	2		
	(b) Components of brass are Cu (1089°C) and Zn (420°C)	1		
	Copper is first melted in a melting pot and then required amount of Zinc added. The surface of the melt is covered with a layer of powdered charcoal to avoid atmospheric oxidation. The molten mass is thoroughly stirred allowed to cool slowly to get brass.	3		5
	Figure.	1		
	(c) advantages: Rate of production is high, Dimensional accuracy and good surface finish obtained. (any two points)	2		
	disadvantages: Toxicity, Explosivity (any two)	2		4